



Armed Forces College of Medicine

AFCM



SOLE OF THE FOOT

**Dr. Mervat Thabet
Prof. Of Anatomy &
Embryology**

INTENDED LEARNING OBJECTIVES (ILO)



-At the end of this lecture, students should be able to:

- 1. Enumerate contents of the four layers of the sole of foot.**
- 2. Describe action and nerve supply of muscles of sole of foot.**
- 3. Describe the origin, course and distribution of medial and lateral planter nerves.**
- 4. Describe the distribution of medial and lateral planter arteries.**

Lecture Plan



1. Part 1 (5 min) Introduction
2. Part 2 (40 min) Main lecture
3. Part 3 (5 min) Summary

Key points



1. Cutaneous nerve supply of the sole of the foot
2. Anatomy of the plantar aponeurosis
3. 4 Layers of the sole and their muscles
4. Distribution of the plantar nerves
5. Plantar arteries

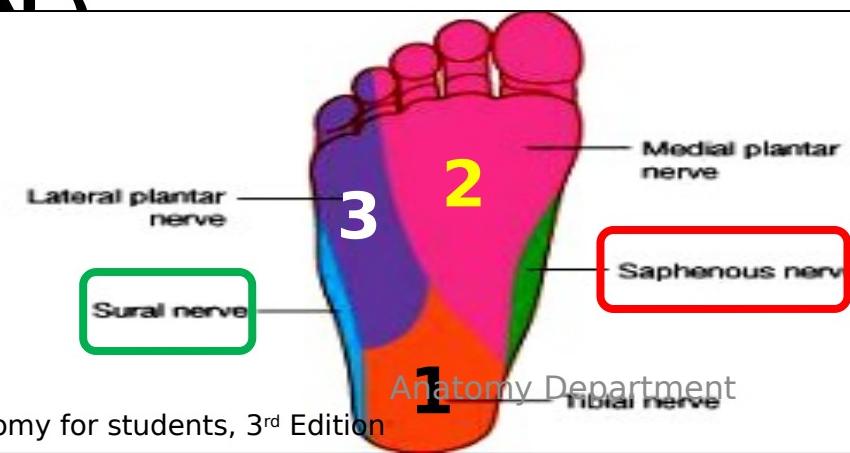
SOLE OF THE FOOT

■ Cutaneous nerve supply of the sole of the foot:

1. Heel is supplied by medial calcanean branches of tibial nerve.
2. Medial 2/3 of the sole & medial 3½ toes are supplied by medial plantar nerve.
3. Lateral 1/3 of the sole & lateral 1½ toes are supplied by lateral plantar nerve.

N.B.: .Medial border of the foot (to the root of big toe) is supplied by saphenous nerve (from femoral N.)

**Lateral
of little
tibial N.**



**e lateral side
l nerve (from**

■ Plantar aponeurosis:

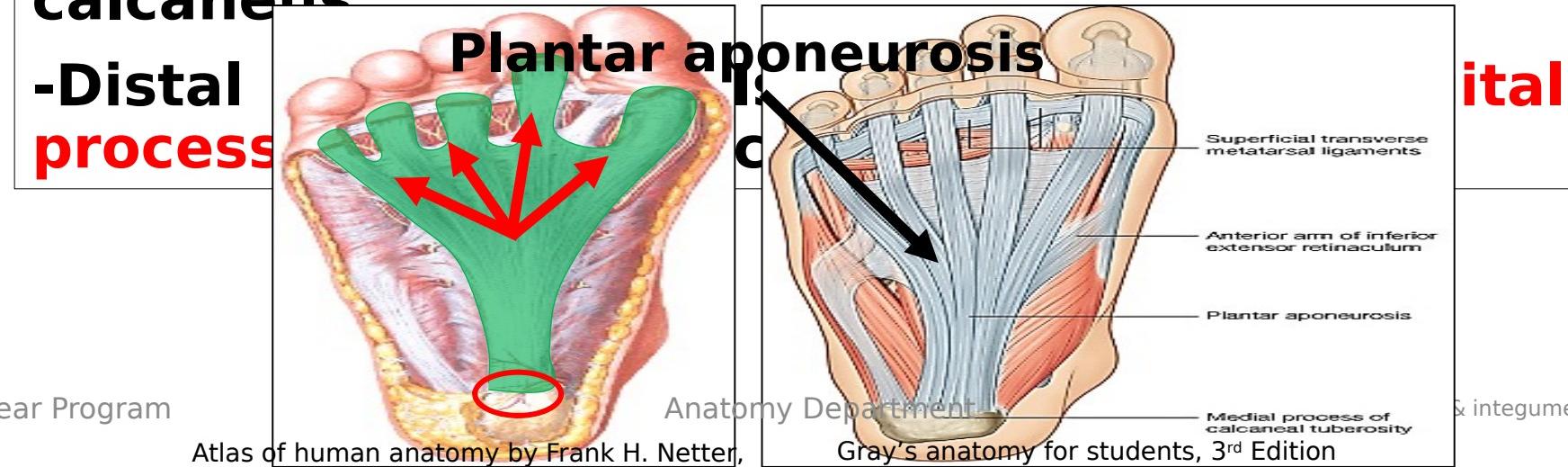
.It is a thickening of deep fascia in the sole of the foot. The central part is the strongest & thickest part, while its medial & lateral parts are much thinner.

Shape: The central part is triangular in outline, having an apex, a base and 2 margins (medial & lateral).

Attachments:

-Proximal end (apex): Attached to the calcaneus

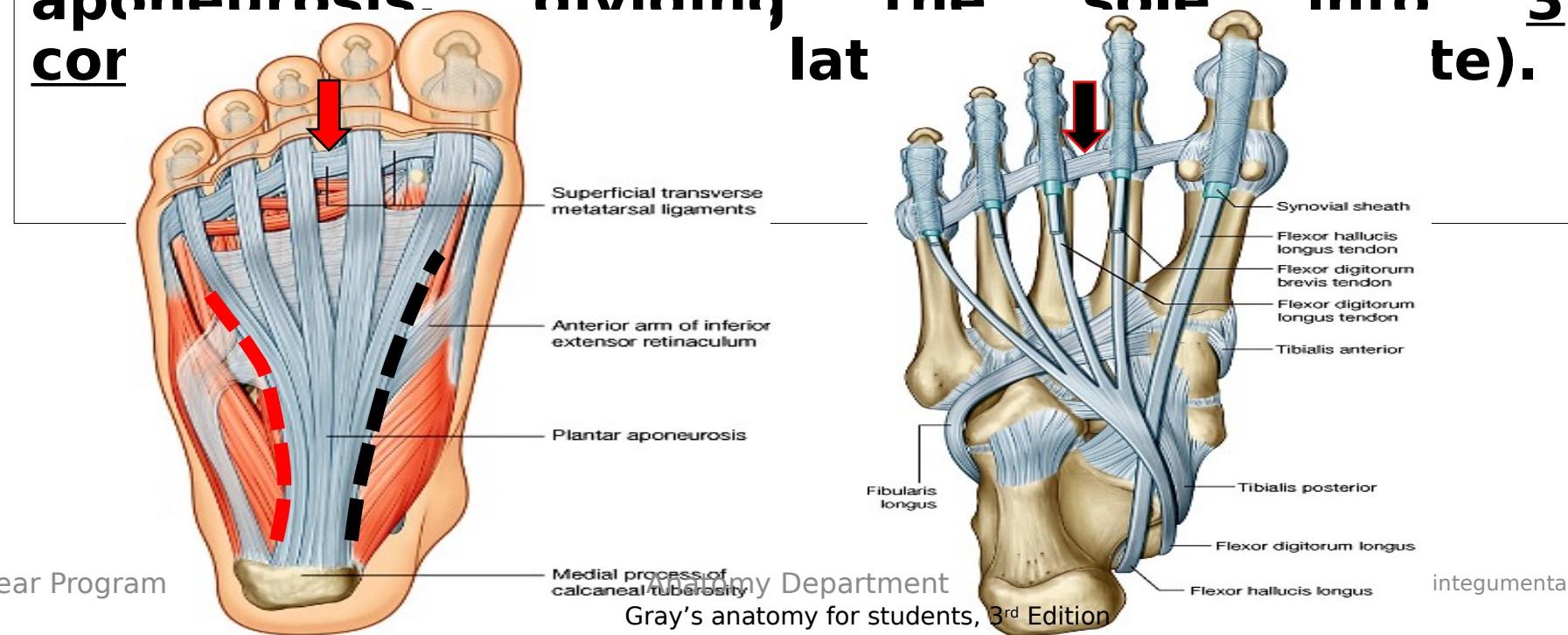
-Distal process



.The digital processes are interconnected by superficial transverse metatarsal ligaments.

-Deep transverse metatarsal ligaments (4) connect the heads of the metatarsal bones together.

.From its lateral and medial margins, vertical septa pass deeply from the plantar aponeurosis dividing the sole into 3 compartments (lat, med, and deep).



.Functions of the plantar aponeurosis: 4

- 1.Fixes the skin of the sole of foot.**
- 2.Protects the deeper structures.**
- 3.Maintains the longitudinal arches of foot.**
- 4.Gives origin to the muscles of 1st layer of the sole.**

N.B. Plantar aponeurosis differs from palmar aponeurosis in giving a digital process to the big toe which restricts its movements. No digital process to the thumb from palmar aponeurosis ⇒ Free mobility.

Layers & muscles of the sole of foot:

■ The muscles and tendons in the sole are arranged into **4 layers**.

. There are **18 Intrinsic muscles & 4 Extrinsic tendons from the muscles of the leg.**

. These muscles are arranged into **4 layers** enumerated **1st to 4th from superficial to deep.**

Below upward

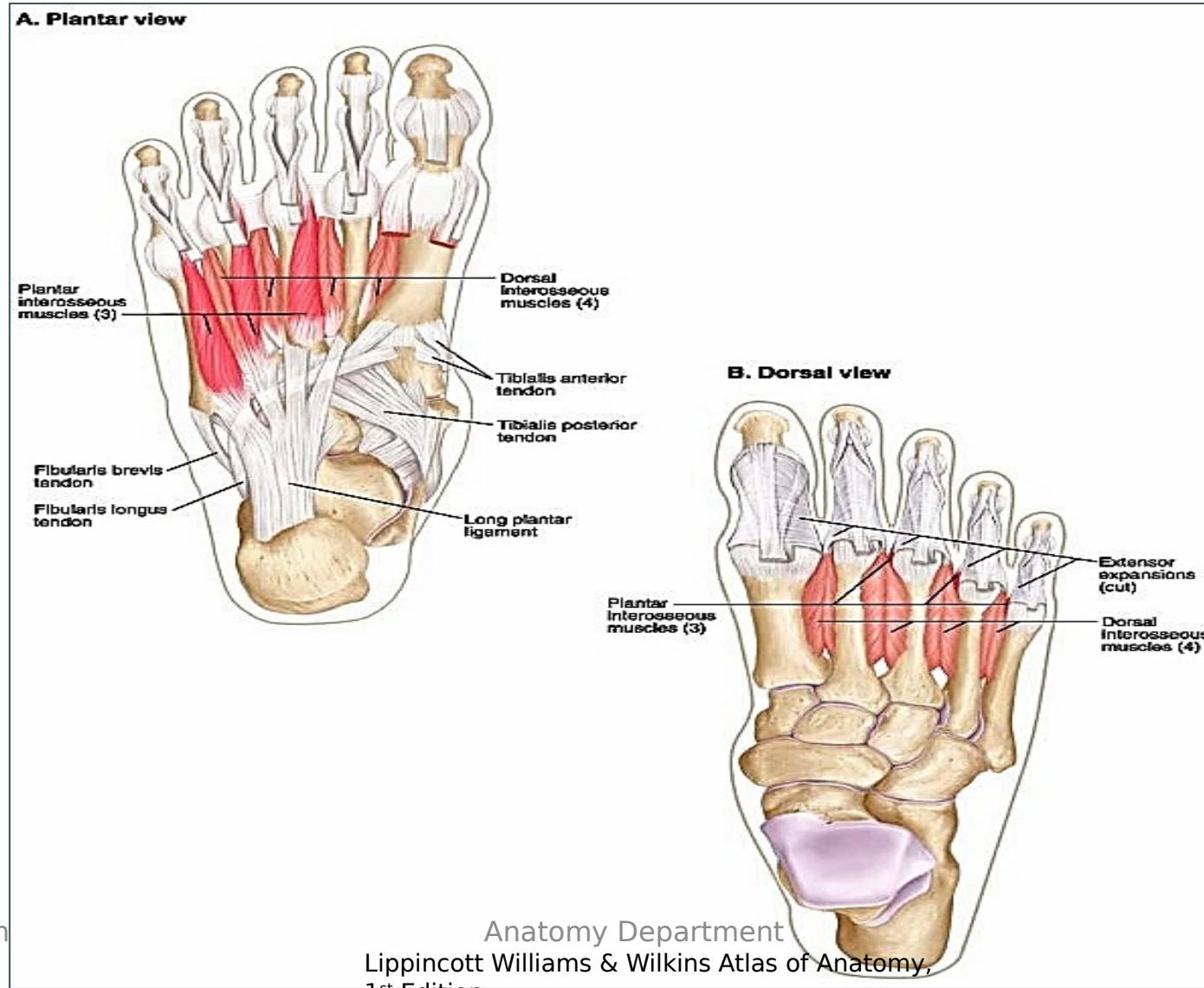
- **1st & 3rd layers are comparable, each has 3 muscles.**

- **2nd & 4th layers are comparable, each has 2 groups of intrinsic muscles & 2 long extrinsic tendons.**

. Of the intrinsic muscles; **14 muscles are supplied by lateral planter N., while 4 muscles are supplied by medial planter N.**

Layers of the sole of foot

4th layer



1st layer of the sole: 3 muscles

2 abductors and one flexor in-between

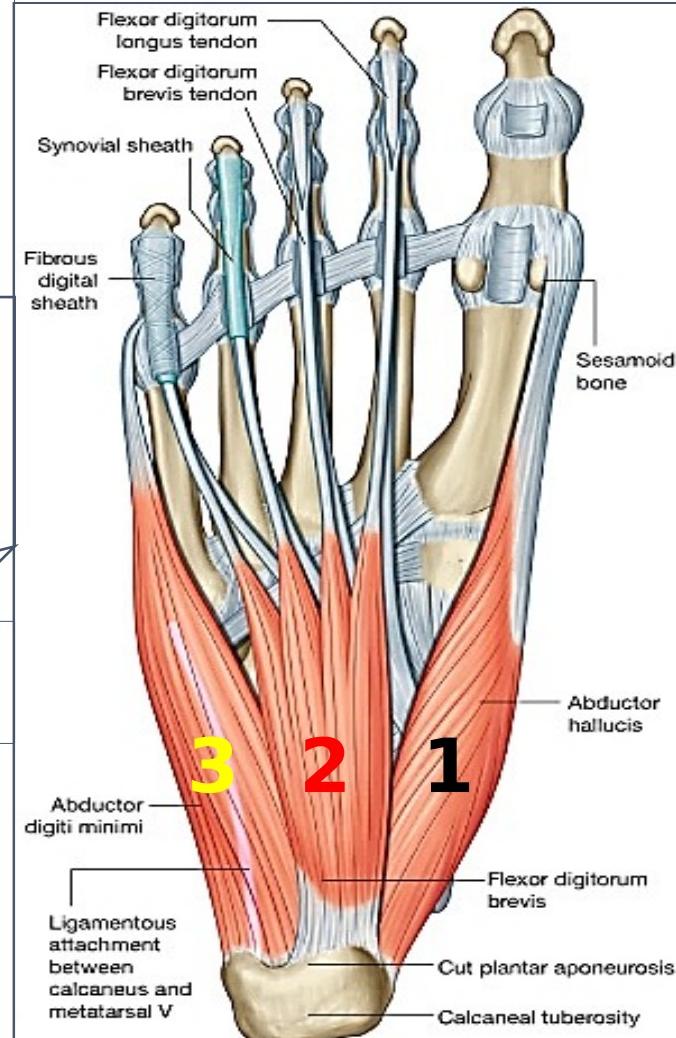
1. Abductor hallucis → Big toe.

2. Flexor digitorum brevis
N. supply: 1 & 2 ⇒ Medial plantar N.
Lateral 4 toes.
3. Abductor digiti minimi → Little toe.
3 ⇒ Lateral plantar N.

Action:

-Abductor Hallucis → Abducts big toe.

-Flexor digitorum brevis → Flexion of metatarsophalangeal (M-P) & proximal interphalangeal (I-P) joints of lateral 4 toes.



Gray's anatomy for students, 3rd Edition

2nd layer of the sole: 2 tendons & 2 groups of muscles

1. Tendon of flexor digitorum longus. **FDL**

2. Tendon of flexor hallucis longus. **FHL**

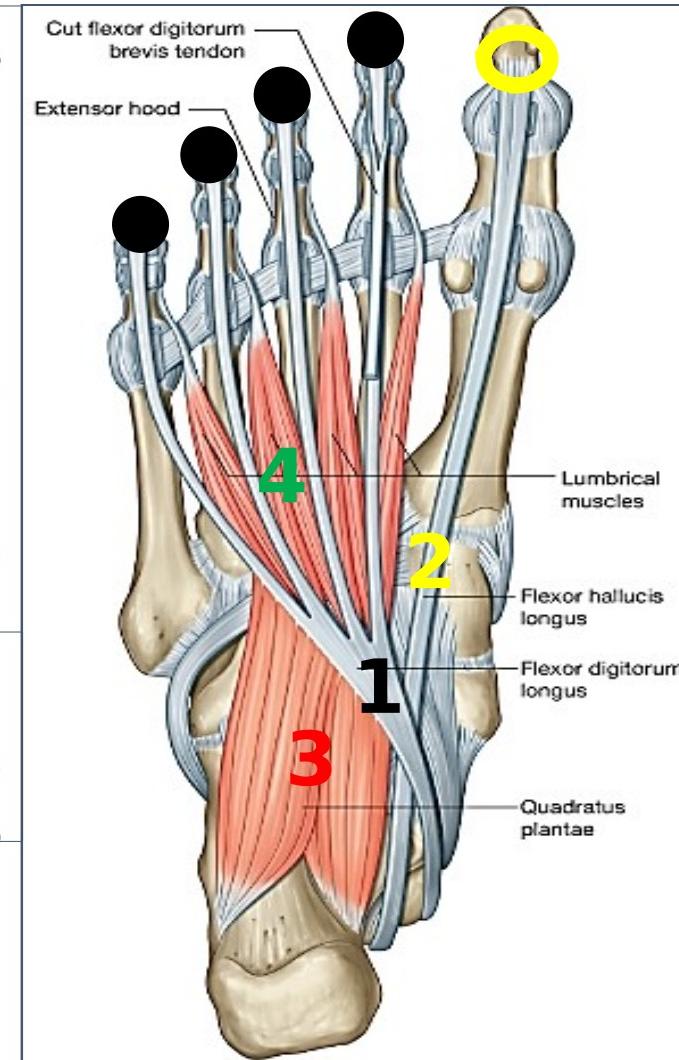
3. Flexor digitorum accessorius [Quadratus plantae].

Tendon of FDL:
4 lumbrical muscles.

-Crosses superficial to the tendon of FHL, from medial to lateral \Rightarrow Lateral 4 toes.

Tendon of FHL \rightarrow Big toe.

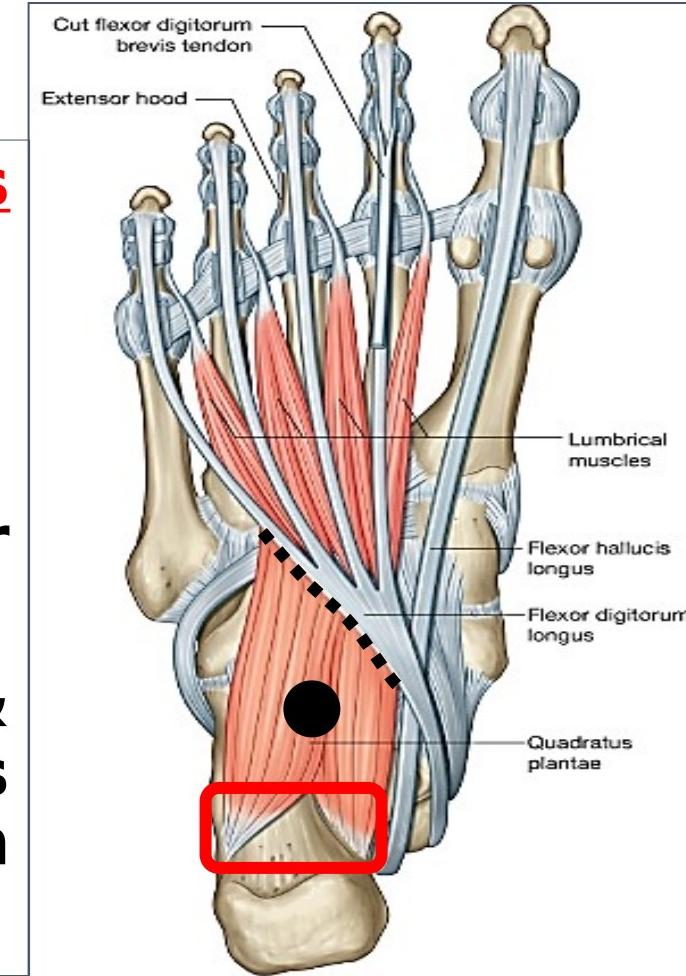
Nerve supply of FDL & FHL:
Tibial N.



Gray's anatomy for students, 3rd Edition

Flexor digitorum accessorius [Quadratus plantae]:

- Origin:** Calcaneus.
- Insertion:** Tendon of FDL.
- N. supply:** Lateral plantar nerve.
- Action:** Helps flexion of M-P & I-P joints of the lateral 4 toes (an indirect action by pulling on the tendons of FDL).



Gray's anatomy for students, 3rd Edition

Lumbrical muscles: 4 muscles;
1st - 4th from medial to lateral.

-**Origin:** Tendons of FDL

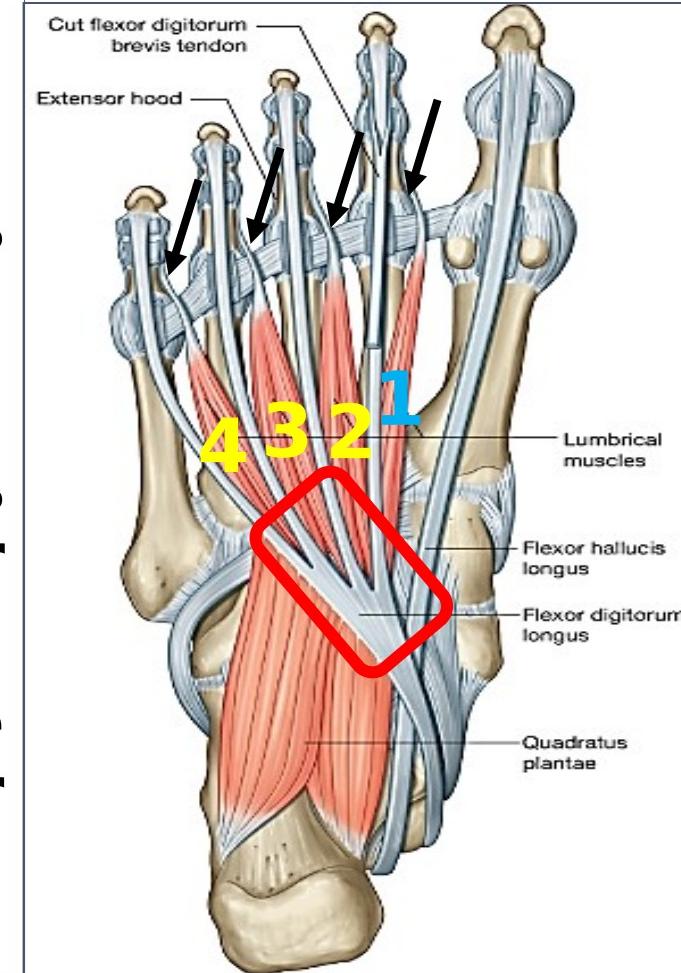
-**Insertion:** Extensor expansions
of lateral 4 toes.

-**N. supply:**

.1st lumbrical (the **medial** one) is supplied by the **medial** plantar nerve.

.The lateral 3 lumbricals are supplied by the **lateral** plantar nerve.

-**Action:** Flexion of M-P joints & Extension of I-P joints of the lateral 4 toes. *Prevent the toes from buckling during walking or*



Gray's anatomy for students, 3rd Edition

3rd layer of the sole: 3 muscles

2 flexors and one adductor in-between

1. Flexor hallucis brevis → Big toe.

2. Adductor hallucis → Big toe.

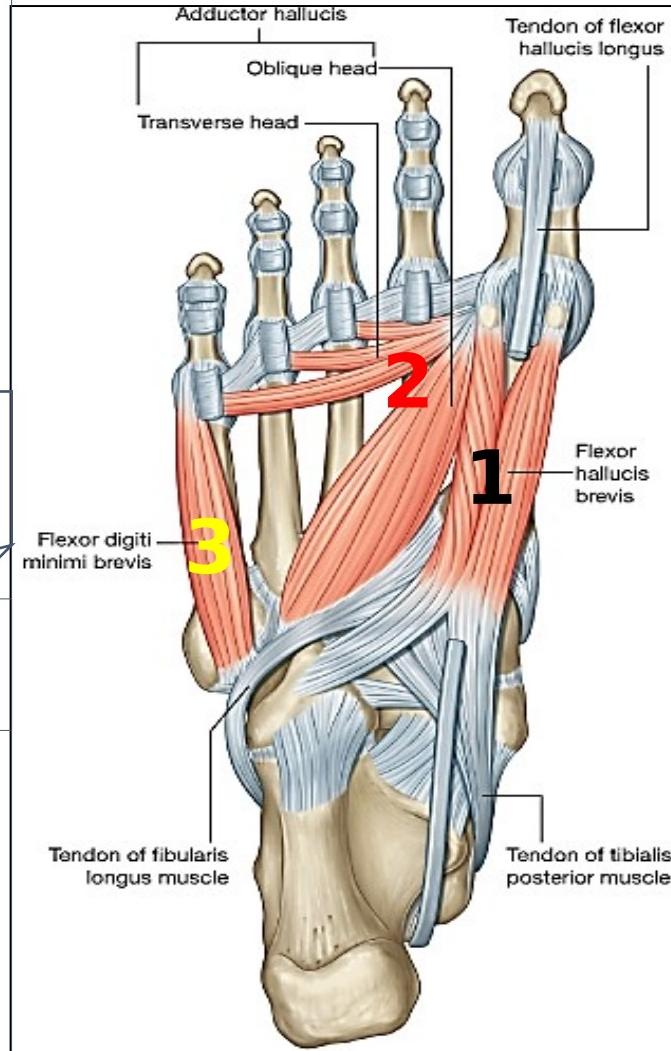
~~Nat supply~~ → Medial plantar N.

~~3. Flexor digiti minimi brevis → Little toe.~~

Action: -Flexor hallucis brevis → Flexion of M-P joint of big toe.

-Adductor hallucis → Adduction of big toe & transverse head maintains transverse arch of the foot.

-Flexor digiti minimi brevis → Flexion of M-P joint of little toe.



Gray's anatomy for students, 3rd Edition

4th layer of the sole: 2 tendons & 2 groups of muscles

1. Tendon of peroneus longus.

PL

2. Tendon of tibialis posterior. **TP**

3. **3 plantar interossei.**

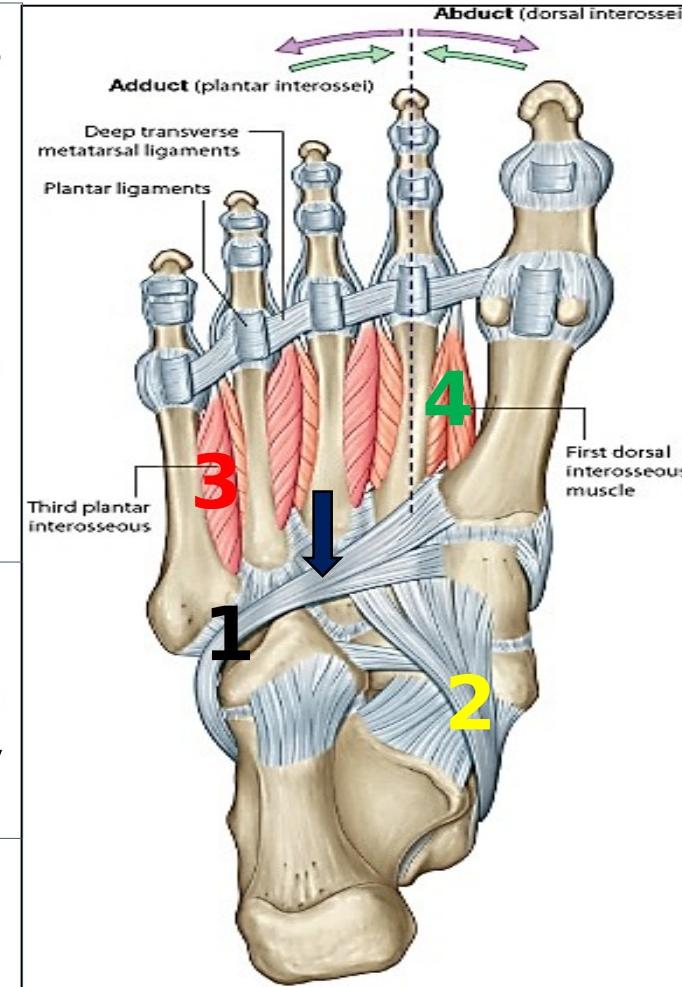
4. **4 dorsal interossei.**

Tendon of PL:

-Passes medially across the sole. It is innervated by superficial peroneal N.

Tendon of TP:

-It is innervated by tibial N.



Gray's anatomy for students, 3rd Edition

Plantar interossei: 3 *Unipennate* muscles

-**Inserted into:** Extensor expansions of lateral 3 toes.

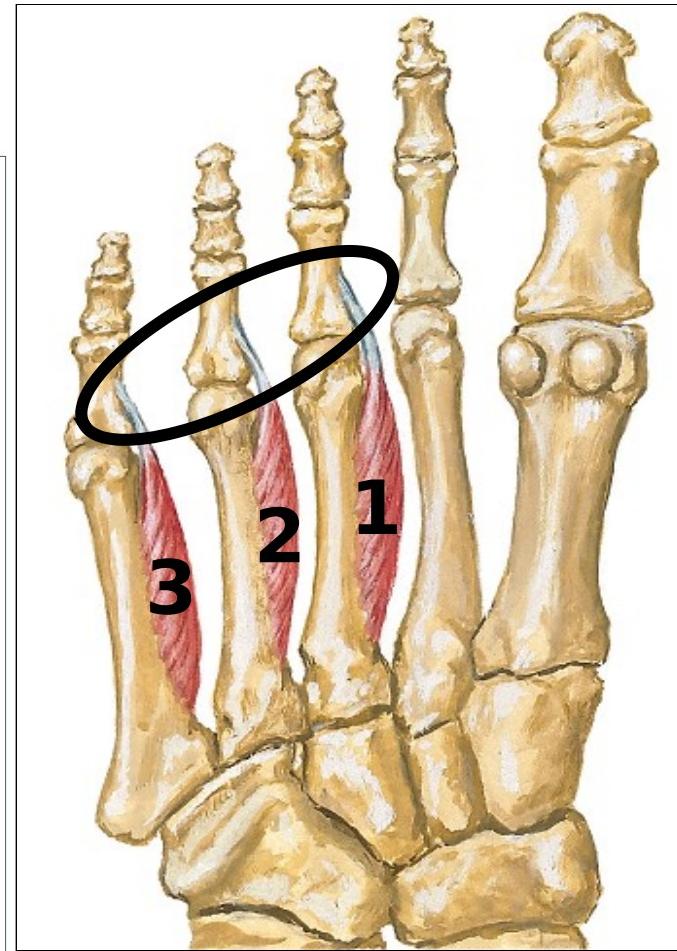
-**N. supply:** Lateral plantar nerve.

-**Actions:** PAD

1. Adduction of lateral 3 toes towards 2nd toe

2. Flexion of M-P & extension of I-P joints of the lateral 3 toes.

To prevent the toes from buckling during walking or running



Atlas of human anatomy by Frank H. Netter,
6th Edition

Dorsal interossei: 4 *Bipennate* muscles

-**Inserted into:** Extensor expansions of middle 3 toes. 2 muscles for 2nd toe

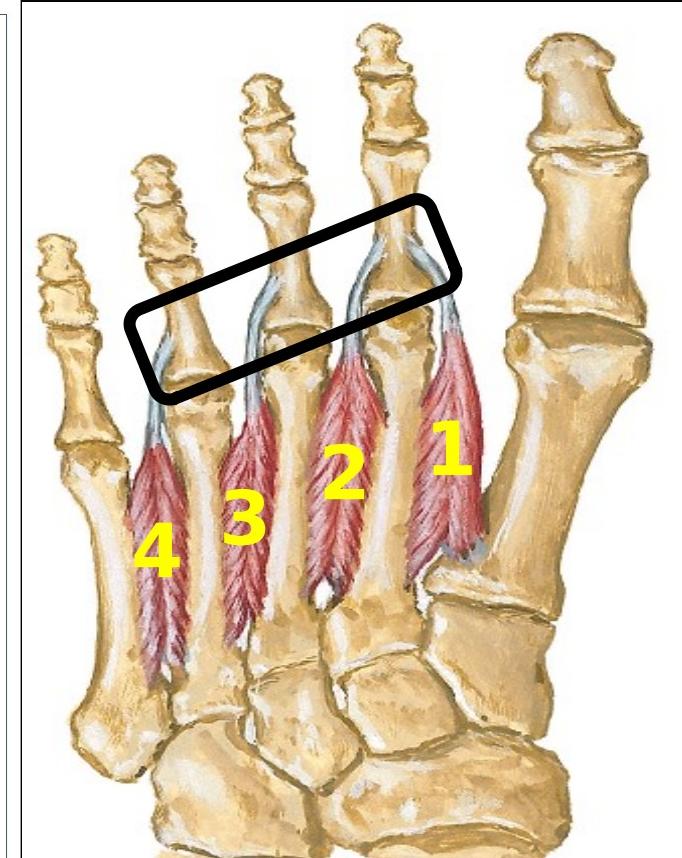
-**N. supply:** Lateral plantar nerve.

-**Actions:** DAb

1. Abduction of toes away from the line of 2nd toe.

2. Flexion of M-P & extension of I-P joints of the middle 3 toes.

To prevent the toes from buckling during walking or



Atlas of human anatomy by Frank H. Netter,
6th Edition

Quiz

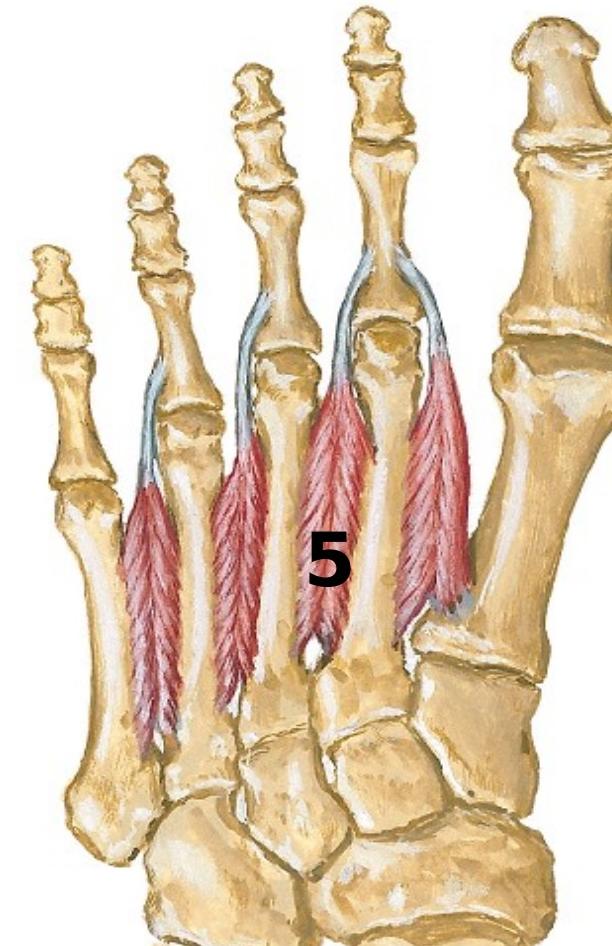
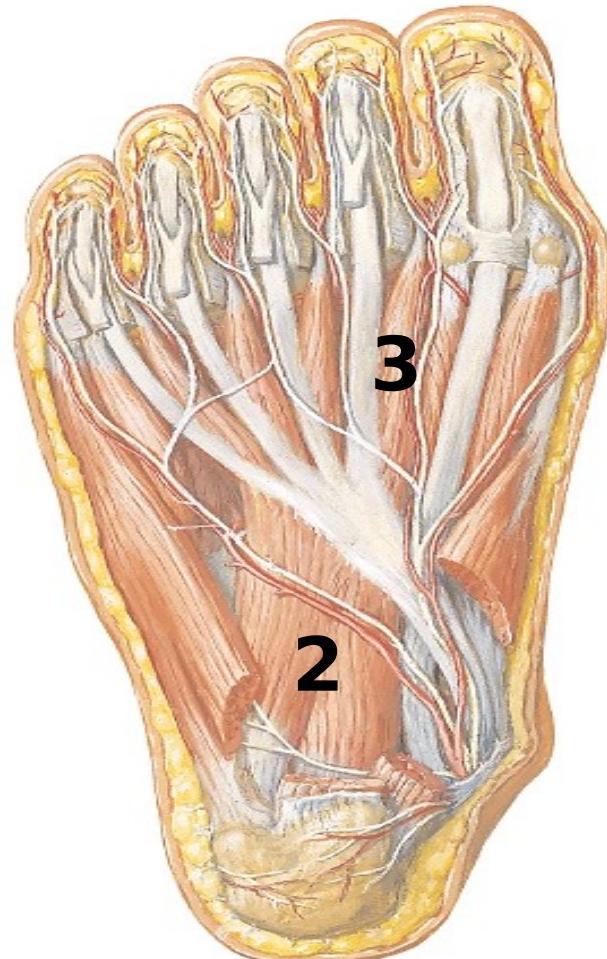


■Which one of the following muscles is present in 4th layer of the sole?

- a. Abductor hallucis brevis**
- b. Adductor hallucis**
- c. Flexor digitorum brevis**
- d. Tendon of FDL**
- e. Tendon of PL**



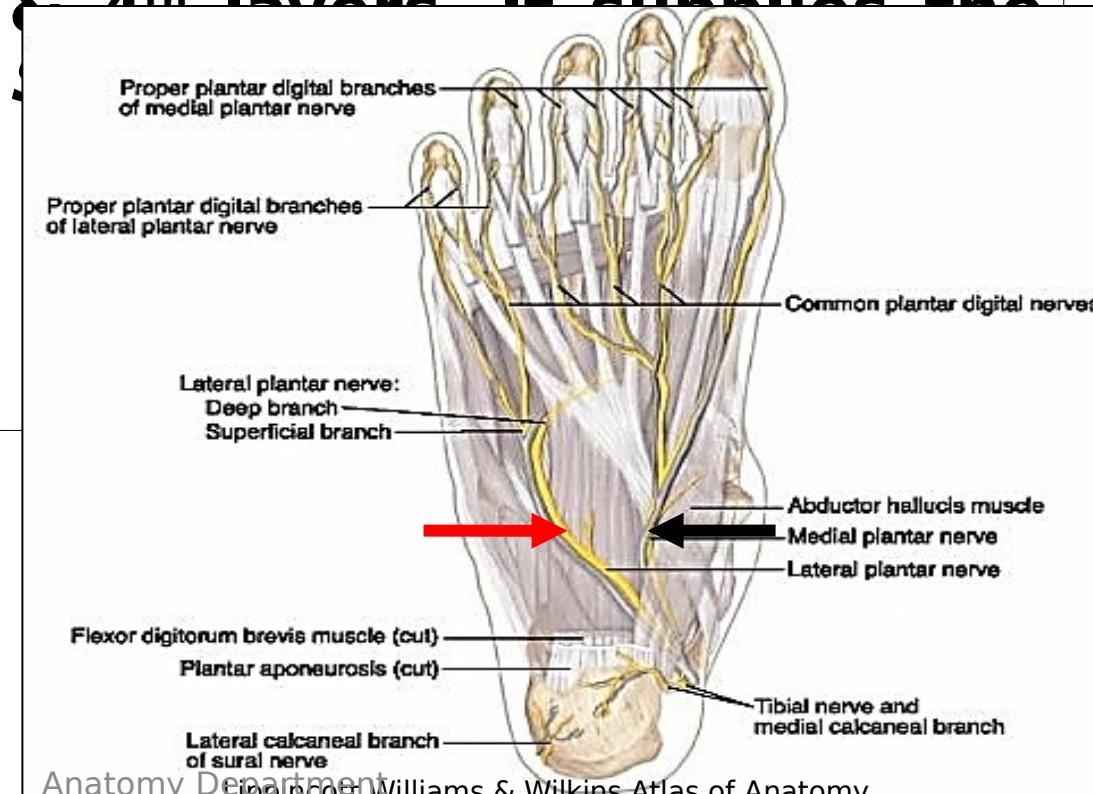
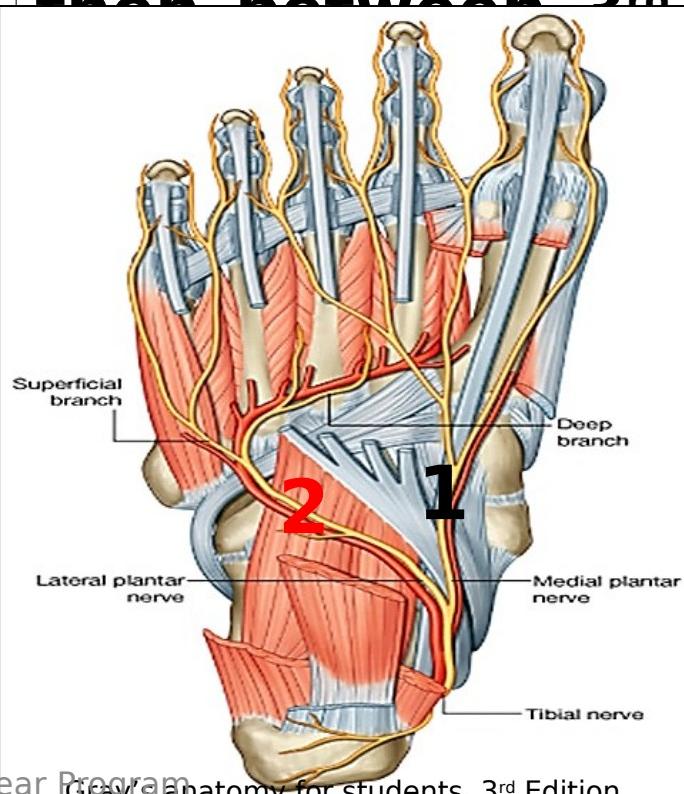
Identify the muscle & its nerve supply:



Atlas of human anatomy by Frank H. Netter,
Anatomy Department 6th Edition

Plantar nerves: Terminal branches of the tibial nerve

- **Medial plantar N.** ⇒ Runs in 1st layer & supplies **4 muscles**; Abductor hallucis, Flexor digitorum brevis, 1st lumbrical & Flexor hallucis brevis. *Similar to median N.*
- **Lateral planter N.** ⇒ Runs between 1st & 2nd, then between 2nd & 3rd, then between 3rd & 4th layers. It supplies the



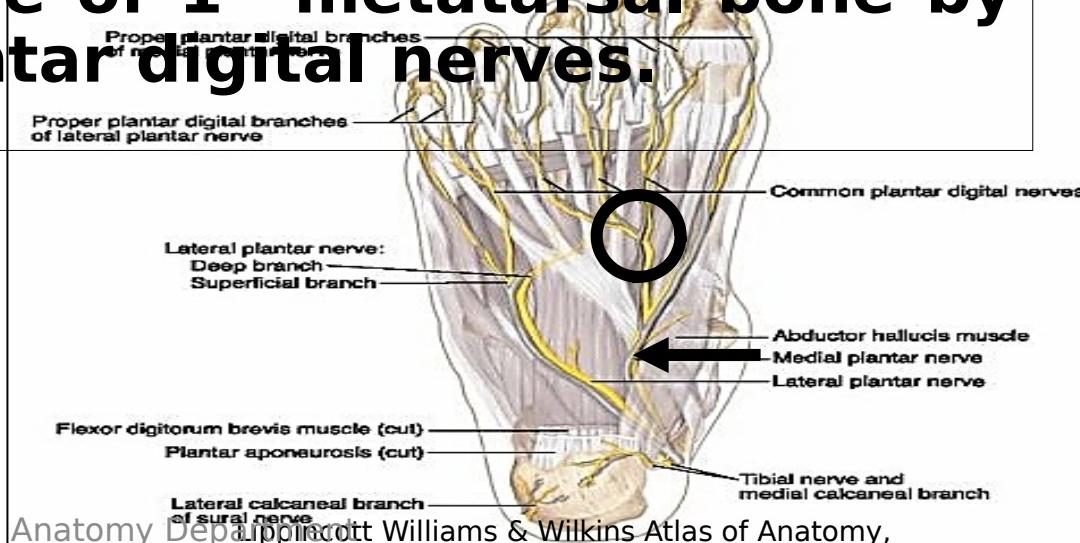
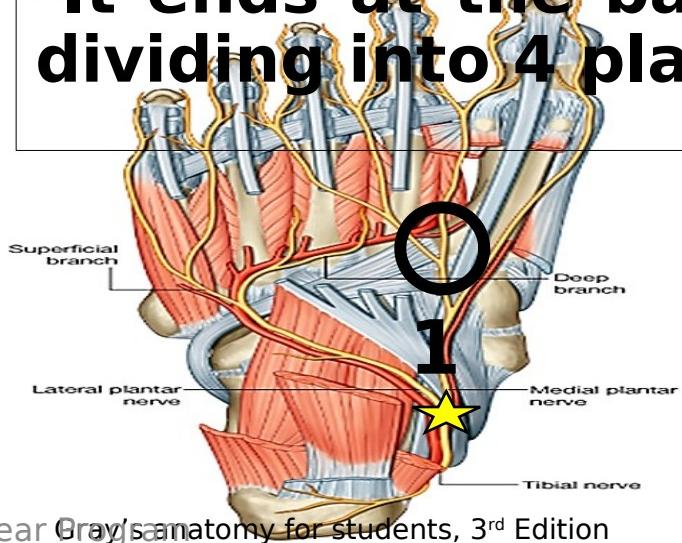
Medial plantar nerve:

■ **Origin:** Arises under cover of the flexor retinaculum as one of the 2 terminal branches of the tibial nerve (midway between calcaneus & medial malleolus).

■ **Course:**

-It runs between abductor hallucis & the flexor digitorum brevis (medial plantar vessels run along its medial side). *1st layer*

-It ends at the base of 1st metatarsal bone by dividing into 4 plantar digital nerves.



■ **Branches of medial plantar nerve:**

Cutaneous to medial 2/3 of the sole & medial 3½ toes.

Muscular: 4 muscles.

1. Abductor hallucis. *1st layer*

2. Flexor digitorum brevis.

3. 1st lumbrical muscle. *2nd layer*

4. Flexor hallucis brevis. *3rd layer*

Articular to joints of the foot.

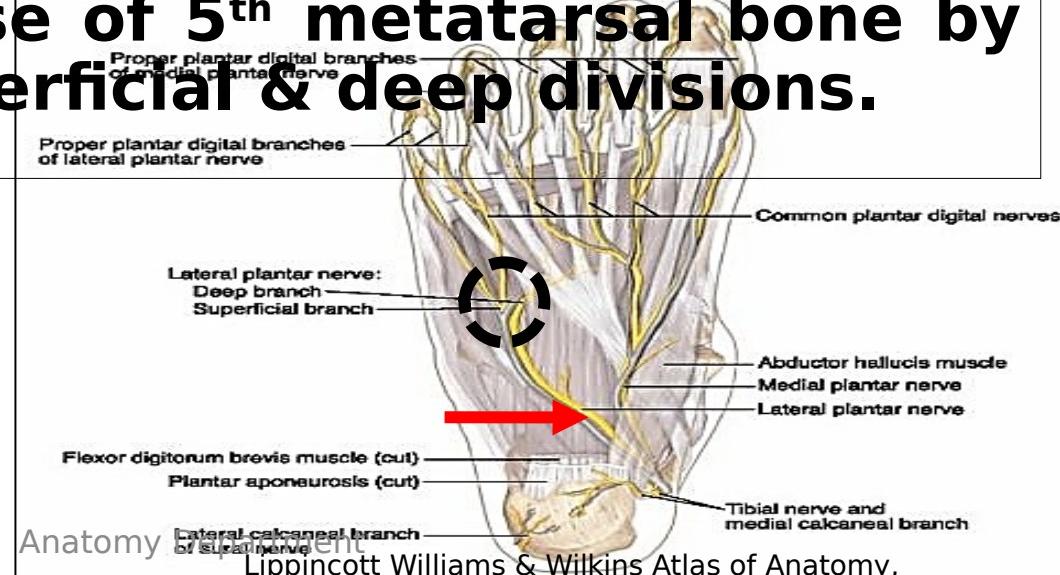
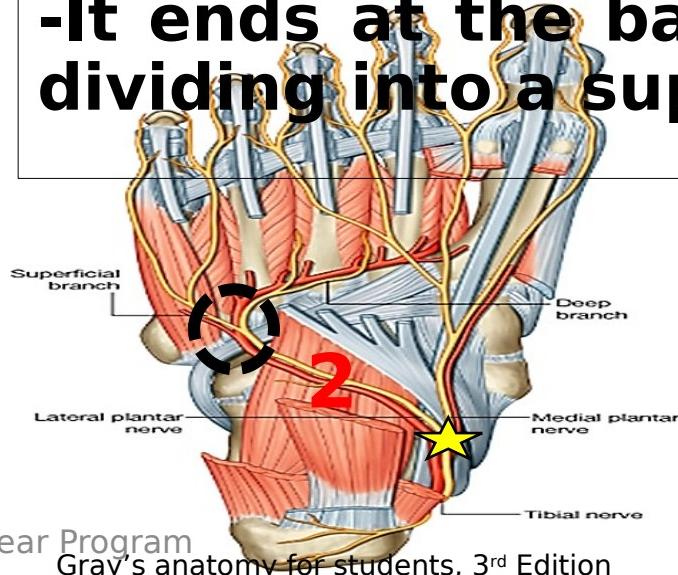
Lateral plantar nerve:

■ **Origin:** Arises under cover of the flexor retinaculum as one of the 2 terminal branches of the tibial nerve (midway between calcaneus & medial malleolus).

■ **Course:**

-It passes laterally between 1st & 2nd layers, (lateral plantar vessels run along its lateral side). *Neuro-vascular plane*

-It ends at the base of 5th metatarsal bone by dividing into a superficial & deep divisions.



■ **Branches of lateral plantar nerve:**

Cutaneous to lateral 1/3 of the sole & lateral 1½ toes.

Muscular to 14 intrinsic muscles.

Articular to joints of foot

Note
that



Medial plantar N. is similar to median nerve in its distribution, while lateral plantar N. is similar to ulnar nerve.

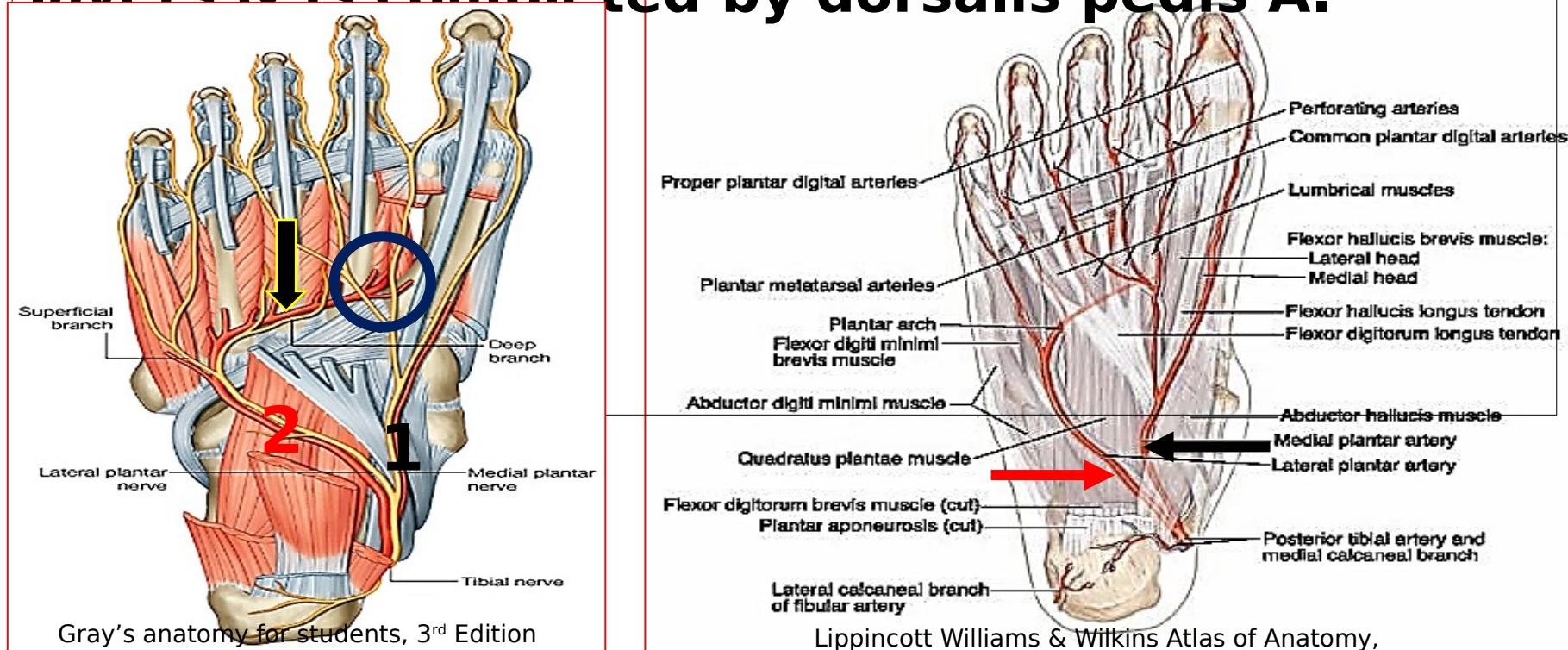
PresenterMedia

**Just a
break**

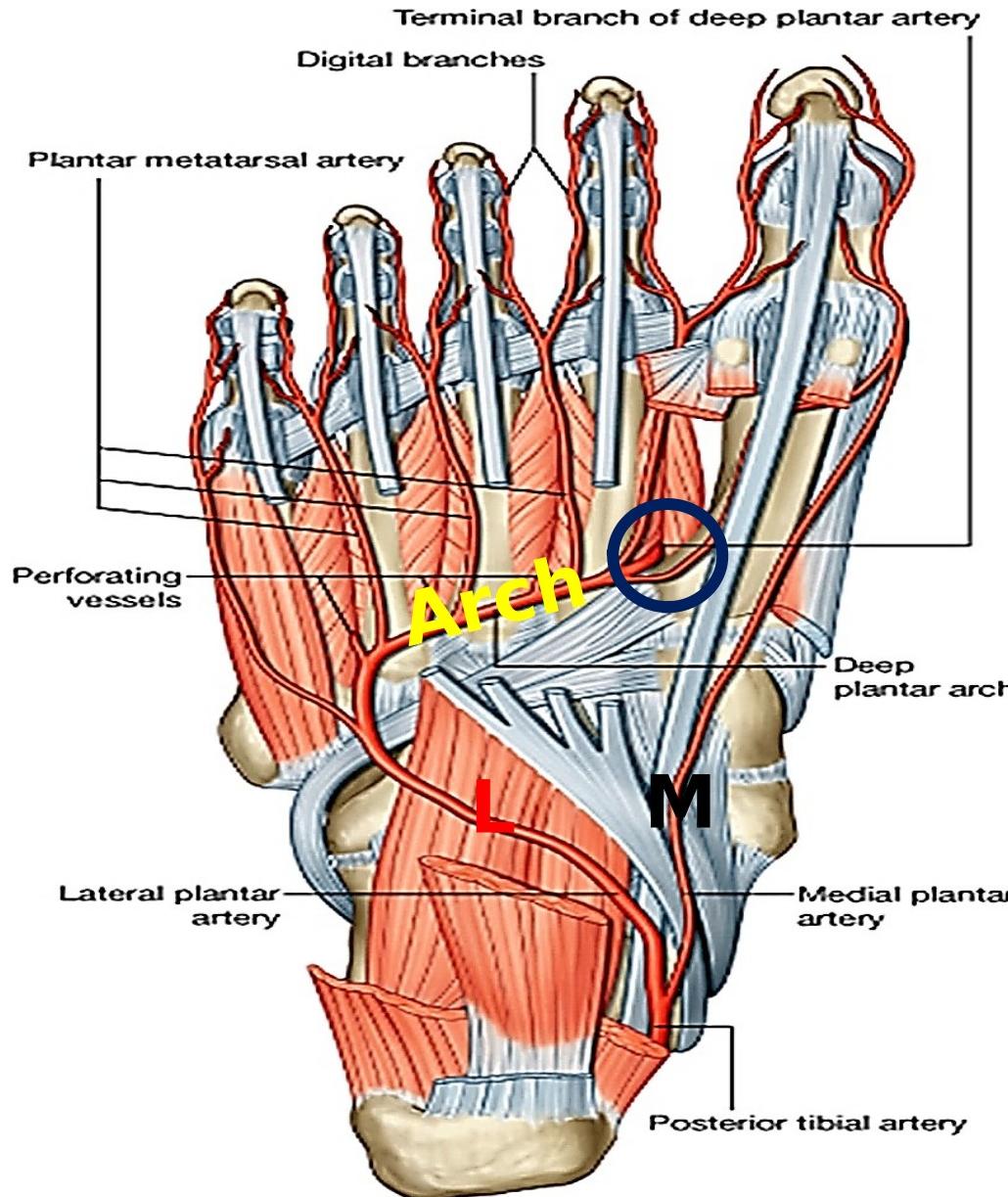


Plantar arteries: Terminal branches of the posterior tibial artery

- Medial plantar A. → Smaller, runs in 1st layer.
- Lateral plantar A. → Larger, runs between 1st & 2nd layers (**neurovascular plane of sole**) & forms the plantar arch which runs between 3rd & 4th layers & is completed by dorsalis pedis A.



Plantar arteries

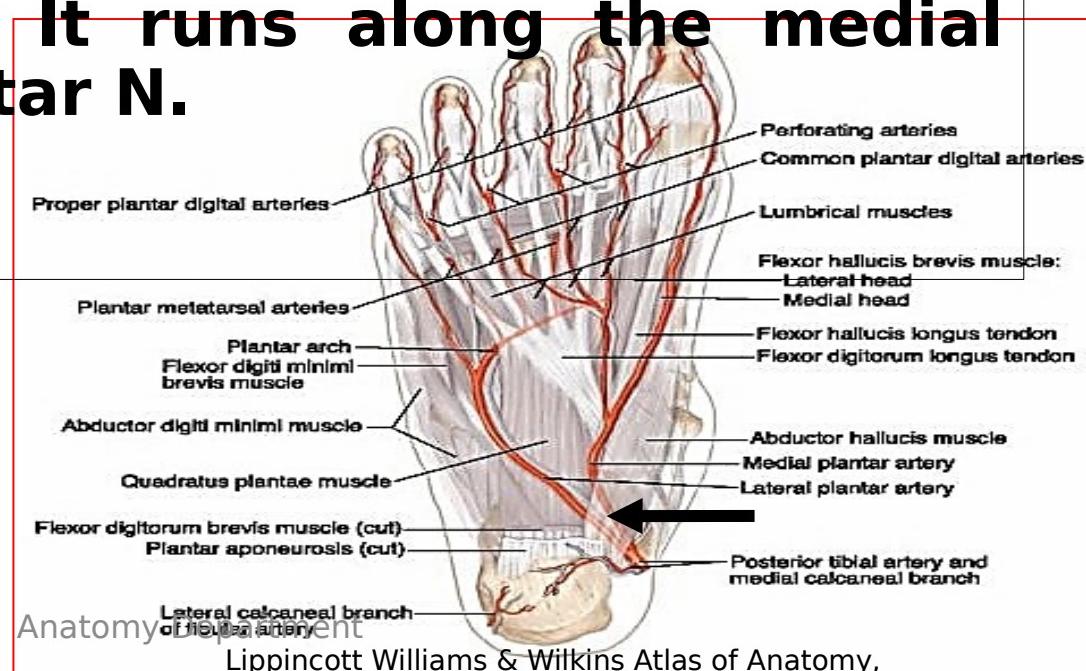
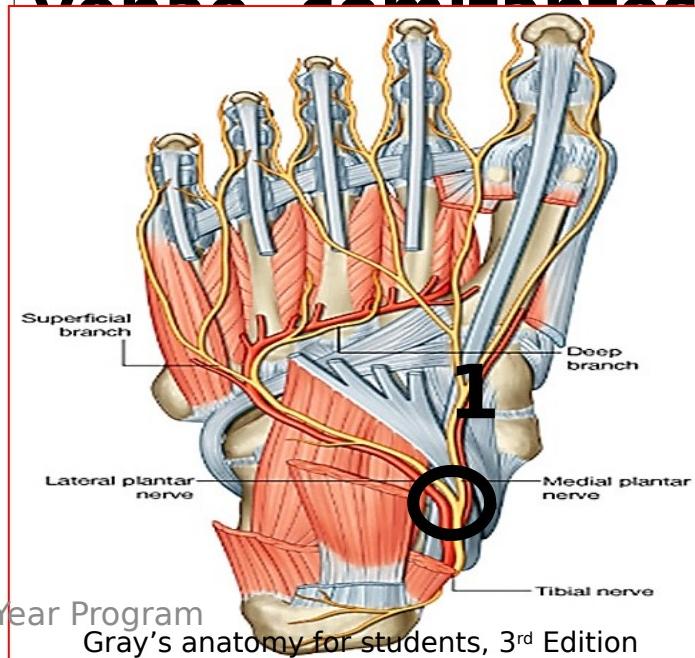


Medial plantar artery:

■ **Origin:** Arises under cover of the flexor retinaculum as one of the 2 terminal branches of the posterior tibial A. (midway between calcaneus & medial malleolus).

■ **Course & relations:** *1st layer*

-It runs forwards between abductor hallucis & flexor digitorum brevis, accompanied by 2 venae comitantes. It runs along the medial plantar N.

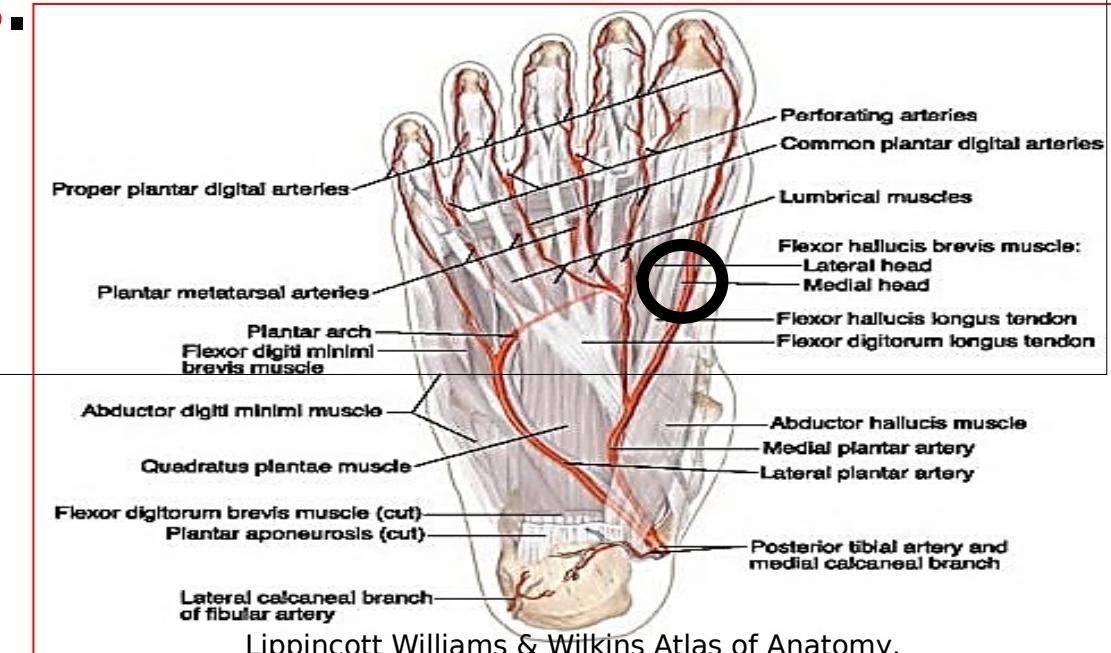
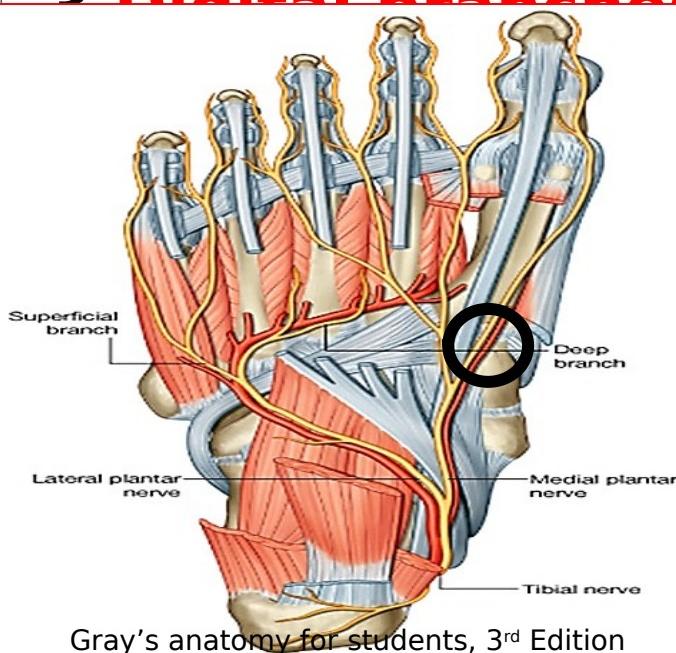


■ **Termination:** It ends at the base of 1st metatarsal bone by anastomosing with the 1st plantar metatarsal A. from *plantar arch*.

■ **Branches:**

- **Muscular to adjacent muscles.**

2. Digital branches.



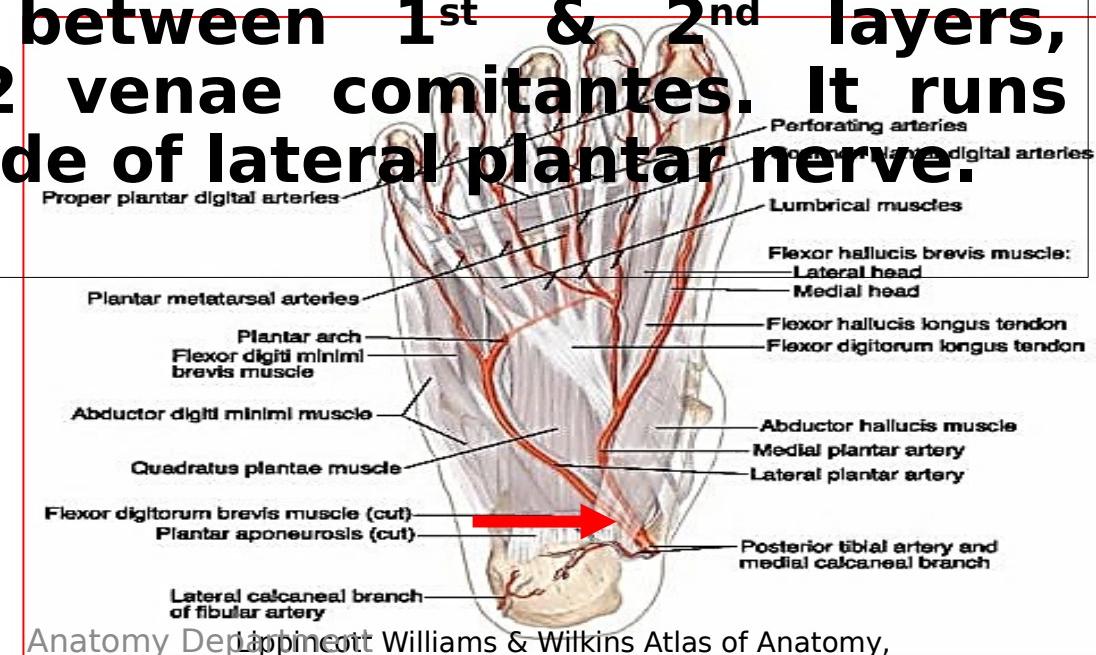
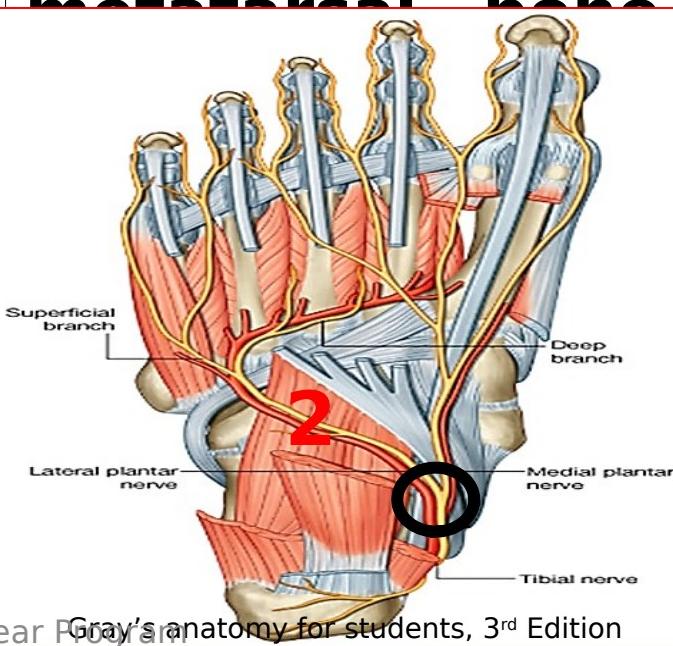
Lateral plantar artery:

■ **Origin:** Arises under cover of the flexor retinaculum as one of the 2 terminal branches of the posterior tibial A. (midway between calcaneus & medial malleolus).

■ **Course & relations:** *In neurovascular plane of the sole*

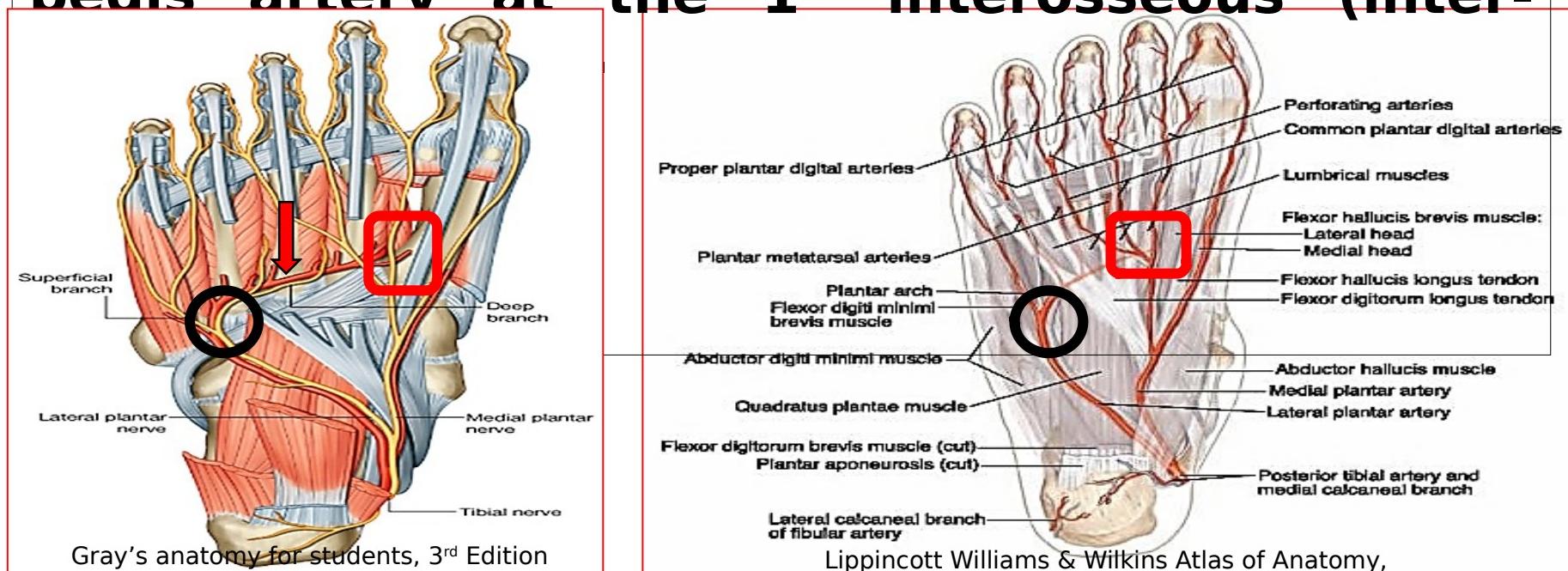
-It passes forwards & laterally to the base of 5th metatarsal bone between 1st & 2nd layers,

2 venae comitantes. It runs side of lateral plantar nerve.



.From the base of 5th metatarsal bone, lateral plantar A. turns medially forming the **plantar arch between 3rd & 4th layers of the sole (with the deep branch of the lateral plantar nerve).**

■Termination: Plantar arch joins the dorsalis pedis artery at the 1st interosseous (inter-



Gray's anatomy for students, 3rd Edition

Anatomy Department

New Five-Year Program

Musculoskeletal & integumentary system

Lippincott Williams & Wilkins Atlas of Anatomy,

1st Edition

33

■ Branches of lateral plantar A.:

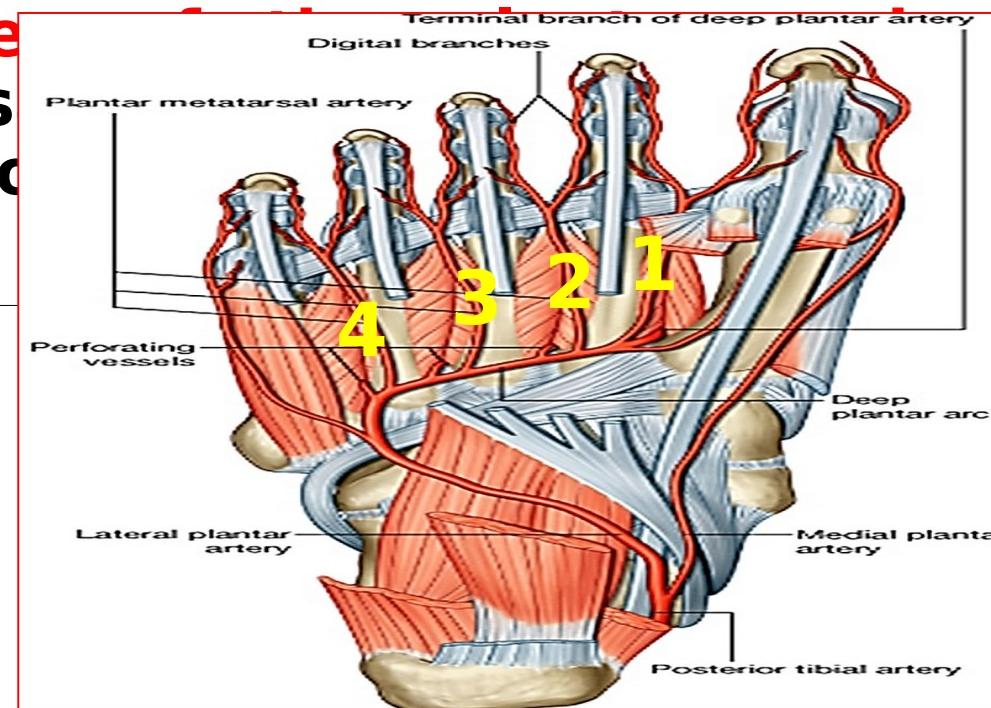
-**Cutaneous** to the skin of lateral part of the sole.

-**Muscular** to adjacent muscles.

-**Anastomotic branches**: with branches of dorsalis pedis A.

■ Branches of lateral plantar artery to metatarsals and phalanges of the foot

4 plantar arteries to joints



Quiz



■ Enumerate the muscles innervated by the medial plantar nerve in the sole of foot

■ Mention the contents of the neuro-vascular plane of the sole?

■ Describe the termination of the lateral plantar artery?

Sole of the foot



Lecture Summary



Neurosis is a thickening of deep fascia in the sole of the foot. Its proximal end or apex is attached to the calcaneus. While its distal part or base is divided into 5 digital processes (one for each toe).

- The muscles and tendons in the sole are arranged into 4 layers.
- There are 18 Intrinsic muscles & 4 Extrinsic tendons from the muscles of the leg.
- These muscles are arranged into 4 layers
- ~~Muscles are supplied by 4th Rbfns misuperficial layer & deepplies 4 muscles while, lateral plantar N. runs between 1st & 2nd layers, then between 3rd & 4th layers. It supplies the other 14 muscles.~~
- Neurovascular plane of sole lies between 1st & 2nd layers and contains lateral plantar N. & vessels.

SUGGESTED TEXTBOOKS



1. Gray's anatomy for students: With student consult online access, 3rd Edition.
2. Snell, clinical anatomy by regions, 9th Edition.
3. Atlas of human anatomy by Frank H. Netter, 6th Edition.
4. Web sites: <https://studentconsult.inkling.com/>
<https://www.clinicalkey.com/student>



BEST WISHES